

Accn. No. 70197
This book

10/197

This book should be returned to the library on or before the date last stamped below.

Date of Release for loan

Date of Release
for loan
the

Stamp below.

| PARA. | PAGE |
|-------------------------------------|------|
| 42. Kamaria Project | 12 |
| 43. Raimanpura Project | 13 |
| 44. Tikria Project | 13 |
| 45. Parlio Nullah... .. | 13 |
| 46. Summary of Investigation | 13 |

NIMBAHERA PARGANAH.

| | |
|---|----|
| 47. Geographical Position | 14 |
| 48. Rivers | 14 |
| 49. Average Rainfall | 14 |
| 50. Towns and Villages | 14 |
| 51. Population | 14 |
| 52. Area and Laud | 14 |
| 53. Wells | 15 |
| 54. Tanks | 15 |
| 55. New Projects—Kadmali Project | 15 |
| 56. Old Tank at Bari | 16 |
| 57. Sabauli Project | 16 |
| 58. Chota Kotri Project | 17 |
| 59. Kheri Project... .. | 17 |
| 60. Bangrera Project | 17 |
| 61. Urgent necessity for Protective Irrigation Works | 18 |

| | |
|------------------------------------|----|
| NOTE BY CONSULTING ENGINEER | 19 |
|------------------------------------|----|

APPENDICES.

| | |
|---|----|
| A. Note on the Bagri Project by the Consulting Engineer | 21 |
| B. Note on the Sohodra Project | 23 |
| C. Note on the Proposed Storage Tank at Mia-ampura | 24 |
| D. Note on the Haripura Project | 25 |
| E. Note on the Sandaro Project | 26 |
| F. Note on the Chandlai Tank | 27 |
| G. Note on the Dakia Project | 29 |
| H. Note on the Kadmali Project | 30 |
| I. Note on the Investigation of Famine Protective Works in the Tonk State by G. E. C. Wakefield, Superintendent Revenue Administration, Tonk. | |

MAPS 1" = 1 MILE.

No. 1. —Tonk Parganah.

No. 2.—Aligarh Parganah.

No. 3.—Nimbahera Parganah.

REPORT ON IRRIGATION IN THE TONK STATE.

The Tonk State consists of six separate and detached Parganahs.

Names of
six Parga-
nahs.

- | | | |
|---------------|---|-------------------|
| (1) Tonk | } | in Rajputana. |
| (2) Aligarh | | |
| (3) Nimbahera | | |
| (4) Chabra | } | in Central India. |
| (5) Sirouj | | |
| (6) Pirawa | | |

This Report relates to the three Rajputana Parganahs, as the present Investigation refers to Rajputana only. Each Parganah is treated separately.

2. After the visit of the Irrigation Commission to Rajputana, on their recommendation a grant was sanctioned by Government for the preparation of certain projects suggested to them as worth further investigation in States without Engineers of their own; and in Tonk this work was kindly undertaken by Mr. Wakefield—an Engineer by profession—who was then Superintendent of Revenue in that State.

Note by Mr.
Wakefield,
lately
Superin-
tendent of
Revenue,
Tonk State.

Mr. Wakefield's Note on the work done and projects prepared under his directions are attached as Appendix I.

TONK PARGANAH.

3. The Tonk Parganah has an area of about 565 square miles; its greatest length from north to south is 50 miles, and its greatest breadth from east to west, 26 miles.

Tonk Par-
ganah.

It is surrounded by the Jaipur State except at the south-east corner, where an out-lying portion of the Bundi State touches it.

The Banas river flowing in a northerly direction on the south-east border here forms the boundary between Jaipur and Tonk; then turning to the east the river flows across the parganah, dividing it into about two equal portions.

The town of Tonk is situated in the centre of the parganah at the south extremity of a range of hills which rise on the right bank of the Banas, and extend on the left bank across the Tonk border into the Jaipur State. With the exception of these hills, the parganah is a plain, nearly all of which is culturable, and a great portion "mal" land, on which crops such as gram, wheat and linseed are grown without irrigation, trusting to the winter rain for a good out-turn.

4. The Mashī River, which rises in Kishangarh and flows through Jaipur, forms the northern boundary of the parganah. Turning south the river enters Tonk and is joined first by the Bagri nullah on the left bank, then by the Lawa nullah and finally by the Sohodra naddi on the right bank before it flows into the Banas, nearly opposite Tonk town.

Rivers.

Further east the Joala and Sohela nullahs which rise on the north-east border of the parganah flow down in a south-west course to join the Banas.

In the southern half of the parganah the south-west corner is drained by the Dakia nullah, which flows in a south-west direction and joins the right bank of the Banas about two miles below that village; and the Chandlai nullah flows from west to east through the centre of this portion joining the Banas at the east border of the parganah.

Average
Rainfall.

5. The average rainfall for the last 10 years is 18·68 inches. The maximum recorded in any year is 35·92 inches, and the minimum 9·20 inches.

Towns and
Villages.

6. There are 250 towns and villages in the parganah, of which 112 are Khalsa, 121 Jagir, 10 Istimrari and 7 Muafi.

Population.

7. The population in the 1891 Census was 114,280; and in 1901 it fell to 85,768, or nearly 25 per cent., due to the Famine.

Area and
Land.

8. Of the total area of 361,503 acres (practically 565 square miles), 178,506 acres are Khalsa, and 182,997 Jagir.

The total area of Khalsa land is distributed as follows :—

| Acres Cultivated. | | Acres Culturable. | Acres Unculturable. |
|-------------------|-------------|-------------------|------------------------|
| Irrigated. | Unirrigated | | |
| 12,915 | 73,560 | 73,505 | 18,527 |

Tanks.

9. There are 150 tanks in Khalsa land, of which 43 only are used for irrigation, the remaining 117 being used simply for the villages and cattle to drink from.

Wells.

10. There are 2,542 Khalsa wells, which according to the settlement irrigate 11,715 acres; or 4·6 acres per well.

In the Famine year of 1899-1900 the wells irrigated 8,074 acres, or an average of 3·17 acres per well; but in 1901-02—another year of drought—only 6,957 acres were irrigated, or 2·6 acres per well, which shows how the water level has fallen.

Water is now about 25 feet below ground surface. The cost of a well varies from Rs. 250 to Rs. 500.

Land
Revenue.

11. The total Land Revenue is Rs. 2,15,876 per annum.

Crops.

For irrigated land the assessment varies from Rs. 2-12 to Rs. 7-8 per bigha; and for unirrigated land from As. 3 to Rs. 1-12. Jowar is chiefly sown in the kharif, jow in the rabi on well land, and wheat and gram on barani "mal" land.

Increase of
Irrigation.

12. Although there is such a large area of "mal" land, which produces crops without irrigation, if this land is manured and irrigated the produce from the crop is said to increase fourfold.

The development of Irrigation, by increasing the number of wells, and the construction of tanks, ought therefore to prove a profitable investment if there are sufficient cultivators to make full use of the water. When the Jaipur-Madhopur Branch Railway is opened the Tonk parganah will be within a few miles of the railway, and connected with Delhi and Bombay; and every encouragement should be given for increasing the grain produce of this portion of the State, and by this means its prosperity, and indirectly its protective power against Famine.

13. The increase of wells can be left to the Revenue Department; and they should see that all existing wells are in working order.

For tanks, at present—except at Chandlai, constructed by Mr. Wakefield (see para. 22)—none of the water that passes down the rivers and nullahs has been utilised, and the existing tanks only store surface water. But all of these should be inspected, a list prepared, and also estimates for any repairs required, and if possible for extending them. This is simple work and can be carried out by the local Public Works Department without assistance; and in this Report new projects only will be referred to.

14. Nothing can be done with the Banas in Tonk. The river has a sandy bed, and is a mile wide in places; and even if any project was feasible it would be far beyond the resources and requirements of this parganah.

Nothing possible on Banas and Mashi.

The Mashi, too, runs in a deep sandy bed, the surrounding country being high, and its extent too limited to make any proposal to bring the flood water on to the surface worth considering.

15. A project for constructing a dam on this nullah at Bagri was surveyed and partly prepared under Mr. Wakefield's directions (see Project No. 2, Appendix I), and in 1901-02 the earthwork on the left bank of the nullah, and a small quantity on the right was carried out as a Relief work, and Rs. 1,670 spent on it. The site (No. 1, Index Map of State) was inspected by the Consulting Engineer for Irrigation in January 1905, and his Note is attached (see Appendix A). In accordance with his instructions fresh Surveys will be made and an Estimate and Plans prepared for completing the dam.

Bagri Nullah.

The soil is all sandy, and a sand dam will be constructed being strengthened across the river bed, where the alignment will be altered from that originally proposed, to top width of 15 ft., front slope 4 to 1, and rear slope 2 to 1.

Mr. Wakefield estimated that 142 m. c. ft. of water would be available for storage, but the catchment area, run-off, and average rainfall appear to have been over-estimated.

The area is only 6.4 square miles instead of 14.5 square miles, and on the sandy catchment not more than 10 per cent. of the average rainfall can be counted on at most. Taking 18½ inches as the average rainfall, in normal years, the most we can hope for is—

| M. c. ft. | Rainfall. | Catchment Area. | M. c. ft. |
|-----------------------|----------------------|-----------------|-----------|
| $2\frac{1}{3} \times$ | $\frac{18\ 7.5}{10}$ | $\times 6.4 =$ | 28 |

The weir will be at the north end of the dam on the right bank, and from the levels previously taken the lowest point crossed by the dam is at the head of a small nullah, which is 20 ft. above the lowest point of the nullah bed; but this depression is narrow, and any flood water passing here would soon cut away a deep natural channel. The dam will consequently be extended till ground surface is reached 24 ft. above the river bed, where there is a long stretch of land about this level, and any water spilling over here is not likely to cut away.

Though the tank is never likely to fill to this level, it will be less costly to raise the dam to the height required for this natural weir level than to construct a permanent weir at a lower level elsewhere; and the portion of the dam already constructed on the left bank will also now come into use.

The Project is not likely to pay; but it will be useful as a Relief work should these have to be opened again. The bed of the tank formed, which is now broken ground, will silt up, and be reclaimed and form good culturable land on which wheat will be produced; and the wells below, the water level in which has fallen, should be benefitted. The Irrigation channel will, it is hoped, also command the two existing tanks at Bagri and form a supply channel to them.

Lawa
Nullah—
Haripura
Project.

16. On the nullah which rises in the Lawa Estate, a site was shown us at Haripura about 3 miles from the border (Site No. 2 Index Map). All the tributary nullahs in Lawa itself are intercepted, so we can only count on the water available from the 12 square miles of catchment in the Tonk Parganah, and as this is sandy, light soil, on 52.5 m.c ft. at most. At the site the nullah runs in deep sandy banks, the land in the bed and on either side the nullah below being much broken up with ravines.

Most of the land available for irrigation is on the left bank and high, and it is very doubtful whether the water will rise sufficiently high to command this.

If the project is carried out, a sand dam will be constructed across the nullah, and as there is no site for a waste weir, the dam will be made high enough to allow the water to spill over the land on the left bank, as proposed in the Bagri Project.

This too will only be useful as a Relief work, and surveys will be made and the project worked out with this object; as beyond the bed, which will be reclaimed and cultivated, very little irrigation below the Dam will be possible. (See Note by Consulting Engineer Appendix D).

Sandaro
Project.

17. Three miles lower down the nullah, at Sandaro, the river bed for about half a mile is a series of ledges of hard rock, on any of which weirs could cheaply be constructed.

The ledge furthest up stream and about a ¼-mile above the village of Sandaro is an specially good site (Site No. 3 Index Map), and being at the highest level gives us a greater head; and levels will be taken to

see if, by constructing a weir here, supply channels could be taken on either bank to supply tanks formed on the plains where good land for irrigation is available, and also to supply existing tanks and naddis.

On either bank of the nullah there is rock for some distance, so to avoid cutting the channel through this the crest of the weir would be made, say 10 ft. (levels will determine this exactly), above the rock ledge in the nullah and 5 ft. above bank level, and the masonry wall would be continued on either side on the rock till crest level was reached, as any flood water falling over the weir on this could do no harm.

On the right bank the ground at first appears very high, and about a mile below, the Miaranpura nullah, with broken ground on either side, would have to be crossed before good land was commanded, so the supply channel on this side may not prove feasible; but on the left bank there is a large area of land between Sandaro and Piplo, on which earthen embankments could be constructed to store water for irrigation, and if, as is anticipated, the levels show that this is feasible, and that the supply channel can also command existing naddis which could be enlarged, and the Piplo Tank, the Project ought to be well worth taking up. In this case the one suggested above, at Haripura, would not be necessary, and the water from 21 square miles of catchment would be available for irrigation. (See Note by Consulting Engineer—Appendix E).

18. On a tributary of the Lawa nullah, which joins the right bank about a mile below Sandaro, there is a good site (No. 4 Index Map) for constructing a tank below Miaranpura. The two branches of this tributary unite just above this village, which is a very small Jagir village, partly deserted since the Famine and now consisting of only about three houses.

Miaranpura
Project.

The catchment area of the proposed tank is 19 square miles, giving 83 m. c. ft. of water available for storage, sufficient to irrigate 830 acres. There is an old naddi on the right bank of the nullah, and the proposed dam would start from and include this, then crossing the nullah just below a well on the left bank would turn to the north-west along the ridge of high ground.

The weir would be at the south end on the right bank, at the point where the present naddi ends, and the overflow would be allowed to spill over the surface, quickly finding its way back to the nullah below, which turns to the south just below the site of the dam.

A masonry core-wall would be necessary for the portion of the earthen dam across the nullah. There is not very much land below the site, as the nullah joins the Lawa nullah a mile below, but all the bed would come under cultivation. The site was approved by the Consulting Engineer (See Appendix C); and surveys will be made, and Plans and Estimates prepared in accordance with his directions, so that the Darbar can carry out the work, if they wish, at any time.

19. On the Sohodra naddi a site for a dam was selected by Mr. Wakefield, near Jawali village (Site No. 5 Index Map, see Project No. 4, Appendix I), and surveys made.

Sohodra
Naddi.

The site was inspected by the Consulting Engineer for Irrigation, but was not approved, and it was not considered worth while working out the Project in detail for the reasons given in his Note (See Appendix B). Lower down no other sites are apparent, so it is feared nothing can be done with this naddi in Tonk territory.

जापला and
Sohela
Nullahs

20. On the Jaola nullah a site was inspected below Rampura village, where the Rampura tributary nullah joins that from Joela; but a tank here would not be of any use as it would submerge a lot of well-irrigated land; and below on the right bank the land is broken and unculturable, while on the left it is Jagir land and already irrigated from wells.

No use either can be made of the Sohela nullah further east, as the land here is rocky and unculturable.

Dakia Pro-
ject

21. South of the Banas, on the Dakia nullah, a Project was proposed by Mr. Wakefield (See Project No. 3, Appendix I). The site selected (No. 6 Index Map) is opposite Kharimpura village, and about a mile above and east of Dakia.

The soil is a mixture of loam and sand, and the river runs in deep banks, the ground on either side being much broken. There is a very fine basin, and from the plans prepared it was proposed to make an earthen dam with crest 38 ft. above the nullah bed, weir level being 5 ft. below this, giving a capacity of about 245 m. c.ft. The land to be irrigated is high, and on the left bank, below Dakia, Jagir land; but on the right bank there is a long stretch of good khalsa land belonging to Arinia and Mendwas villages. But to command this, according to the levels, the sill level of sluice was to be 9 ft. below weir level, so that the bottom 24 ft. of water stored would not come into use. The catchment area has been taken as 37 square miles; but we were informed that some portion of this is intercepted by existing tanks at Sakna and Lachmipura. But even allowing the whole 37 square miles to be available, and 10 per cent. of the average rainfall of $18\frac{3}{4}$ —which is the maximum possible on the sandy catchment—we can only expect to store—

$$2\frac{1}{2} \times \frac{18 \cdot 75}{10} \times 37 = 161 \cdot 8 \text{ m. c. ft.}$$

so that the tank would not fill to the level proposed.

The site was inspected by the Consulting Engineer (See Appendix G), and according to his instructions fresh surveys will be made to check what has been done already, and to see the lowest level possible for sill of sluice; and the catchment area will also be carefully inspected to see exact area unintercepted. If under the altered conditions the Arinia and Mendwas land can be commanded, it will be a good Project; the dam will not be expensive as it will be entirely of earth; the line will be crooked to avoid broken ground and to keep on the higher ridges to save earth-work. As the Irrigation Channel will be now only on the right bank, the weir will be made on the left bank, a long channel being cut round, away from the dam, till the broken ground below is joined.

22. On the Chandlai nullah a project was prepared by Mr. Wakefield for a Storage Reservoir at Chandlai itself (Site No. 7), about 4 miles south of Tonk town (See Project No. 1, Appendix I); and the work was carried out as a Famine Relief Work in 1901-02, and the dam, which is entirely of earthwork, completed to within 3 ft. of full height proposed.

Chandlai
Tank.

Up to date Rs. 14,610 have been spent on the work.

During the last rains the dam breached at the south end, apparently no arrangement for overflow water had been made; for although the dam was incomplete in height—the original weir level had been left unaltered—the water therefore rose higher than intended before the dam breached, and as the earth is inferior, the front slope of the dam has been badly cut away by waves for nearly the whole length, and evidently will not stand at a slope of 3 to 1.

The Consulting Engineer inspected the tank and gave directions as to the repairs he would recommend (See Appendix F).

These directions should be carried out without fail before next rains, otherwise further failure of the dam will probably occur. The earth is not reliable enough to allow of the dam being raised any further, and arrangements to allow the flood water to spill over at the south end must be made, the earthen dam being stopped when ground level 5 ft. below the crest level is reached, the ends being well pitched.

23. The only other project which appears feasible in the Tonk parganah is at Achnero, 7 miles south-east of Tonk on the Aligarh Road. There are two small tanks by the village, but the tributary, nullah to the Chandlai passes to the north of the village, and is not intercepted.

Achnero
Project

This is a small Project and consists in connecting the two village tanks and continuing the dam across the nullah till high ground on the left bank is reached (Site No. 8).

The catchment area is only 2 square miles, but the water on this is now lost, while there is land below the village to be irrigated; and the bed of the proposed tank, which is at present all broken ground, would be reclaimed and cultivated as the water receded.

24. Surveys will be made and the Plans and Estimate for this, and all the other Projects noted in this Report, submitted in due course, for consideration by the Durbar.

A Loan for
Irrigation
Works sug-
gested.

The great advantages to the State by gradually carrying out all that has been suggested, and increasing irrigation in every way, have been pointed out in para. 12 above. If the finances of the State prevent anything being done at once, it would be well to consider whether it would not be worth while to raise a loan for Irrigation works alone, and to engage a competent Assistant Engineer (Native) to supervise the work in the three parganahs. Every year deferred is revenue lost to the State; and works decided on should be carried through and completed without delay, as until completed they can give no return on the money expended.

ALIGARH PARGANAH.

Physical Features.

25. The Aligarh Parganah lies south-east of the Tonk Parganah, and separated from it by a strip of the Jaipur State about 10 miles wide.

It has an area of 156 square miles : its greatest length from north to south is 15 miles ; and greatest breadth from east to west 12 miles.

It is bounded on the east, north, and north-west by the Jaipur State : on the south by Kotah ; and south-west by Bundi.

The northern half is rich "mal" land, all of which is cultivated and produces wheat, linseed, and gram without irrigation ; in the southern portion the greater part is rocky and unculturable land, ridges of slate on edge running across the country, and being close below the surface throughout, so that the area of cultivated land is limited and near the villages.

Drainage Areas.

26. The Parganah consists of undulating country, intersected by nullahs. A ridge runs across from the centre of the south-west border to the north-east, forming a dividing watershed. On the north of this ridge two nullahs rise and flow through the north-west corner of the Parganah ; and on the south five nullahs flow in a south-east direction, all being tributaries of the Chakan maddi, which forms the south border, dividing the Parganah from Kotah.

Average Rainfall.

27. The average rainfall for the last 10 years is 25·36 inches, the maximum recorded in any year was 4·18 inches, and the minimum 16·10 inches.

Villages.

28. There are 89 villages in the Parganah, of which 48 are Khalsa, 37 Jagir, 2 Istimrari and 2 Munfi.

Population.

29. The population was 19,623 in 1891, and 17,062 in 1901, or a decrease of 13 per cent.

Area and Land

30. Of the total area of 100,123 acres (156 square miles) 40,621 acres are Khalsa and 59,502 Jagir ; or nearly $1\frac{1}{2}$ times the Khalsa area.

The following is the distribution of Khalsa land :—

| Acres Cultivated. | | Culturable. | Unculturable |
|-------------------|--------------|-------------|--------------|
| Irrigated. | Unirrigated. | | |
| 1,957 | 17,550 | 18,814 | 2,300 |

Tanks.

31. There are 48 Khalsa tanks, but with the exception of the Mana tank built at Aligarh last Famine, they are not intended for Irrigation, and are small, catching only the surface drainage, and no use is at present made of the main nullahs, the water of which passes away out of the Parganah.

32. There are 439 wells in Khalsa land which irrigate 1801 acres, a little over 4 acres per well; and in the Famine year 1,314 acres were irrigated from wells, or 3 acres per well. Since the Famine the water level in the wells has fallen considerably, and about Aligarh itself, of the 80 wells belonging to the village 20 only are now said to be in use. Wells.

The complaint of deficiency of water in the wells was general in all the villages visited.

33. The total Land Revenue is Rs. 35,147. The assessment varies for irrigated land from Rs. 5-11 (maximum) to Rs. 2-4 (minimum); and for unirrigated land from Rs. 1-2 to As. 3. Land Revenue.

34. The above figures show what an increase in Revenue can be realised if Irrigation is extended and increased. Increase of Irrigation.

There are sites on nearly all the nullahs where storage tanks could be constructed and the only reason, it is imagined, why no advantage of these has been taken is, that the northern portion of the Parganah, with its "mal" land, produces good crops without irrigation; and the opinion prevails that owing to the slate rock with vertical fissures close to the surface, especially in the southern portion, tanks even if constructed will not retain water which disappears through the rock fissures.

In reply to this, it can only be pointed out that where tanks have been constructed in the northern portion, as at Patoli and Soulatpura by Jagirdars, they are a great success; and I was informed that the value of the Jagirs had very largely increased in consequence, owing to the irrigation.

Under both these tanks I saw excellent crops, and the difference between the irrigated wheat and that on barani land was most marked.

The dams of the few tanks I saw in the southern portion were breached, and had not been repaired for the reason given that the water stored quickly disappeared through the rock below. I am inclined to think that the failure in these tanks is that no masonry core-wall was constructed, and the water escaped between the earth and rock at the bottom of the dam, and holes having occurred in the earthwork, this eventually caused a breach.

In the southern portion I would certainly recommend masonry core-walls in any dam constructed. Even should the tanks leak, the beds—many of which are now broken ground—would all be reclaimed and cultivated; and the water level in the wells below would be raised.

The works proposed and noted on below are small, so no great initial expenditure will be necessary, and I would strongly recommend the tank at Kherli in the north, and Govindpura in the south being constructed, to start with, as soon as possible. If, as anticipated, they prove a success and benefit to the Parganah, there will be no hesitation in taking up the

others. If not carried out before, the State will at any rate have a fixed Famine programme for the Parganah worked out, as all the works proposed will be most suitable for Relief works.

Bamania
Project.

35. Taking the two nullahs in the north-west corner of the Parganah, at the first village one passes on entering the Parganah from Tonk-Bamania (Khalsa) there is a good site (No. 1 Index Map) for a dam about a quarter mile below the village, and the villagers are most anxious for its construction, as half their wells are dry.

The catchment area is 2.3 square miles, so that we should have 13.5 m. c. ft. of water available for storage, allowing 10 per cent. of the average rainfall of $25\frac{1}{2}$ inches; or sufficient for 135 acres.

Starting from high ground on the left bank—where there would be a natural weir—the dam would circle round across the nullah up to the village, which is on a high mound, and would form part of the dam, which will probably have to be extended across a low depression on the north of the village.

Three wells, close to the village, would be submerged, but they have little water in them; the basin is good, and there is a nice stretch of good land below, down to the border, available for irrigation.

Oklano
Project

36. At Oklano (Khalsa), a mile to the east of Aligarh, there is an old naddi, the dam of which extends from the village southwards to the bank of a nullah, the flood water of which is at present not stored.

This dam should certainly be raised and extended to include this nullah (Site No. 2), giving a total catchment area of 1.2 square miles, and 7 m.c.ft. of water available for storage. The dam would be entirely of earthwork and would be extended on to the high ground on the left bank of the nullah, and perhaps may join the dam of the "Mana" tank constructed last Famine.

The bed of the Oklano tank is at present all cultivated, and perhaps a little of this would be lost by enlarging the tank as now proposed, but there is a good area of land on the right bank below Aligarh, which would be commanded, and though there are a number of wells on this area which are at present dry and the land in consequence only cultivated in the Kharif.

Kherli Pro
ject.

37. There are two sites on the Kherli nullah, the one (Site No. 3^A) at Kherli village (Khalsa) itself, starting from a high mound about $\frac{1}{2}$ mile to the north-east of the village on the right bank, and ending at the mound on which the village stands; the other (Site No. 3^B) about $\frac{3}{4}$ mile east of the village at the junction of the two branch nullahs.

Site No. 3^B would be the longer dam of the two, and would command the Kherli land east of the village on which there are three dry wells. Site No. 3^A would submerge this land, but would command all the land below the village on the west, and also that of Bandria (Khalsa)

village on the right bank. The catchment areas and water available etc. for storage are :—

| | Catchment Area. | Water available. | Area which would be irri- gated. |
|---------------------|--------------------|---------------------|--|
| | sq. mile. | m. c. ft. | acres. |
| Site 3 ^a | 2½ | 14·8 | 148 |
| „ 3 ^b | 2 | 11·7 | 117 |

An earthen dam is all that is required, and the flood water allowed to spill over the land on either side.

Both are very good projects. The basins are good and there is plenty of land below at present unirrigated ; surveys will show the cost of each, and the Durbar can then decide which to take up. The Patoli Tank, which is such a success, is at the head of the catchment and only two miles from Kherli, so that the Durbar should have no hesitation in carrying out one of the Projects proposed.

38. The five nullahs which flow down to the south-east corner of the Parganah will now be considered. Bhagwanpura and Alipura are two Jagir villages close together, about 5 miles south-east of Aligarh, belonging to Sahibzada Abdul Wahab Khan. There is a good site (No. 4) between the two villages for constructing a Storage Reservoir on the nullah which flows past them on the east : the catchment area is two square miles and water available for storage 11·7 m.c.ft., sufficient to irrigate 117 acres.

Bhagwan-
pura and
Alipura
Projects.

The village of Bhagwanpura would be submerged, but it only contains three houses, and these could be removed at little expense to Alipura. The basin is at present broken up with small ravines, on the nullah banks ; but these would all be reclaimed and cultivated as the water receded.

There is plenty of land below. There are five wells in the two villages, but all are dry except one ; only an earthen dam is required, and the water could be allowed to spill over at either end. It will not therefore be an expensive Project, and has everything to recommend it. If the Jagirdar is not in a position to carry out the work himself, the Durbar should make some arrangement for its execution.

39. At the head of the next nullah to the east, at Daulatpura, a small tank has been constructed by the Jagirdar Sahibzada Abdul Alim Khan, and has proved of great benefit to the village ; and further east, 2½ miles from Bhagwanpura, two nullahs join just below and east of the Khalsa village of Mandawar. On the right bank of these, north-west of the village, there is an old maddi, and below this the remains of an old earthen dam ; but the nullahs themselves have not been bunded, and it is now proposed to store this water (Site No. 5). Below the village the Khalsa land is limited. The nullahs run in deep banks ; and the land in the

Mandawar
Project.

basin rises rapidly and is high, so that it is not such a good project as those noted on above, but it is worth carrying out, as all the broken ground in the bed would be reclaimed and cultivated; and if not constructed before, it would be an admirable Relief work, as the dam will be entirely of earth.

It would start from the naddi on the right bank, include the old earthen-breached dam, and cross the nullahs, following the ridge of high ground on the left bank. This line is taken, as if the dam was taken lower to cross the nullah at the junction of the tributaries, cultivated well land would be submerged. The catchment area is 1.8 square miles, and 10.6 m.c.ft. of water should be available for storage, sufficient to irrigate 106 acres.

Site inspected at
Shadri.

40. The Bhagwanpura and Daulatpura nullahs unite three miles south of these villages, near Moa village, the former being joined at Nari, two miles north-west of Moa, by another tributary.

Nothing more is possible with these, as south of Nari and Moa the land is nearly all rocky and unculturable.

The Mandawar nullah flows down in a southern direction past the Jagir villages of Sop, Maderpura, and Galwania, all of which have sufficient wells for the culturable land, and joins the Moa nullah at the Khalsa village of Shadri (see Index Map), which was visited, as it seemed a possible site for constructing a large Storage Reservoir at the junction of the nullahs; but they flow in very deep banks here, and the land for Irrigation is high on either bank and limited in extent, so that it was not considered worth further investigation.

Govindpura
Project.

41. Taking the nullah west of Moa, two miles to the south-west there is an old deserted village called Govindpura (Khalsa), where there is an old broken dam on a rocky ridge (Site No. 6). There is good land below, a good basin, all waste land, and if the dam was reconstructed it is proposed to restore the village and start it afresh. The catchment area is 2.4 square miles, and as it is rocky 20 per cent. of the rainfall should be available for Storage, or 28 m.c.ft., sufficient for 280 acres. The Project is a good one, and Surveys and Estimates will be prepared. The dam breached probably as there was no core-wall, and on the rocky ridge this is necessary. A natural weir should be constructed at the west end on the rock. An earthen dam may be necessary, running from south to north, on the ridge forming the water-shed between the Govindpura and Kamaria nullahs, to prevent water escaping on this side, but levels will show this.

Kamaria
Project.

42. At Kamaria there is a very fine site for a Storage Reservoir (Site No. 7), the largest of all inspected, as the catchment area would be 8.5 square miles, the main nullah rising 4 miles to the north, by Deoli, and being joined on the right bank by another tributary 1.4 miles above Kamaria. There is a splendid basin, and all waste land, the catchment area being for a great part rocky and unculturable and used as a shikar preserve. With this catchment we can allow 20 per cent. of average rainfall of 25.7 inches as available for storage, or 100 m.c.ft.

Below there is land—I was informed 2,000 bighas, or 1,250 acres—available for Irrigation. If this is correct the Project would certainly be worth carrying out ; but surveys will show this exactly.

The dam would start from the rocky ridge at the west end of which is Kamaria village : and a natural weir could be formed on this ; crossing the nullah, the dam would join the ridge of high ground on the left bank. A masonry core-wall would be necessary throughout the length of dam ; the nullah is in deep banks about 15 ft. high, with slate rock on edge in the bed. The water stored below bank level would be lost for Irrigation, but would, no doubt, be useful as a drinking supply for the animals in the shikar preserves.

43. Further west the land on either side the nullah which flows by Jhondua and Sundarli is rocky and waste, the nullah itself flowing in a deep ravine, but on the Roheth nullah, about a mile west of Raimanpura, there is a site (No. 8) for a Storage Reservoir, with land below on either side the nullah, belonging to Raimanpura and Subhanpura villages (Khalsa).

Raiman-
pura
Project.

The dam would start from a rocky ridge on the left bank, on which a natural weir would be formed, crossing the nullah where there is a slate bed, it would pass on to the high ground on the right bank which consists of earth. A masonry core-wall will be provided in the dam for its whole length. The catchment area is 1½ square miles, and with 15 per cent. of the average rainfall would give 15·6 m.e.ft. of water for storage, sufficient to irrigate 156 acres.

44. Below Raimanpura the Sundarli and Roheth nullahs meet by Tikria village, and on the right bank below there is excellent land between Chan and Rasulpura villages, which is only cultivated at present in the Kharif. If a chain of low earthen dams, to store the flood water from the nullah, were constructed on the water-shed ; and a supply cut taken from a weir built across the river at Tikria (Site No. 9), or at the point which the levels show to be high enough to command these tanks, all this land could be irrigated. The river has cut its way through a bed of slate all the way from Tikria to Chan, so a weir can cheaply be built at any suitable point. The catchment area at Tikria, excluding that of the tank proposed at Raimanpura, is 9½ square miles ; as a greater part of this Catchment is rocky, we can count on 15 per cent. of the average rainfall being available for storage, or 82·5 m.e.ft. of water, sufficient for 825 acres.

Tikria
Project.

45. There is one more nullah, which crosses the south corner of the Parganah at Parlio (Khalsa). It runs in very deep banks and the land to be irrigated is high. As the bed is all rocky, weirs could easily be built at suitable places across the river and the water held up, and raised to the land on either side by odhis, if there are sufficient land and cultivators to make full use of the water.

Parlio
Nullah.

46. It will be seen from the Index Map that the Choru Pachala nullah in the north-east corner of the Parganah is the only one for which proposals have not been made. This was not investigated as the villages and land here are all Jagir, and large tanks already exist, it is understood, at Choru and Pachala.

Summary
of Investl-
gation.

Of the nine Projects suggested all but one are in Khalsa land and for the benefit of Khalsa villages; Plans and Estimates for all will be submitted in due course for the Durbar's consideration.

If the conclusions arrived at in para. 34 are correct, it will be seen there is plenty of work to be done for the improvement of irrigation in the Parganah, and if carried out these should prove of great advantage to the State.

NIMBAHERA PARGANAH.

Geographical Position.

47. The Nimbahera Parganah lies about 130 miles south-west of Tonk, separated from it by portions of the Mewar and Jaipur States.

It has an area of 387 square miles; is bounded on the north-west and south by Mewar, and except in the east—where it is bounded by the Neemuch District of the Gwalior State—is very irregular and broken in shape, with several areas detached and separated from it entirely, and surrounded by the Mewar State.

Rivers.

48. The largest river is the Gameri, which rises in the high lands of Central India in the Gwalior State, about 18 miles north-east of Neemuch Cantonment, crosses the east border near the large village of Keli, and flows in a north-west direction for 12 miles across the Parganah, where it enters Mewar, and joins the Berach river 14 miles further on at the foot of Chitor Fort. The Gameri is joined about 6 miles north-east of Nimbahera town by the Kadmali, which is the principal river, as with its tributaries, of which the Daru is the most important, it carries away nearly all the drainage of the Parganah. The Kadmali rises about 7 miles east of Bari Sadri in Mewar, through which it flows for 6 miles, and then continues its course for 20 miles in a northerly direction through the Parganah.

Average Rainfall.

49. The average rainfall for the last ten years is 21.62 inches. The lowest rainfall was 5.51 inches recorded in the Famine year of 1899-1900; and the maximum 36.96 inches, recorded in the year following.

Towns and Villages

50. The only town is Nimbahera: and there are 219 villages, of which 152 are Khalsa, 18 Jagir and 49 Istimrari.

Population.

51. In the 1891 Census the population was 64,888; and in 1901 it was reduced to 40,499, or a decrease of 37½ per cent., due to the Famine.

Area and Land.

52. Of the total area of 247,727 acres (387 square miles), 163,405 acres are Khalsa and 84,322 Jagir. The following is the distribution of the Khalsa area:—

| ACRES CULTIVATED. | | Acres Culturable. | Acres Unculturable. |
|-------------------|--------------|-------------------|---------------------|
| Irrigated. | Unirrigated. | | |
| 13,401 | 56,744 | 67,711 | 25,549 |

53. There are 3,906 wells in the Khalsa area, which irrigate 12,649 acres, or practically all the irrigated land. This gives an average of 3.2 acres per well. During the Famine the wells only irrigated 3,470 acres, less than one acre per well. Wells.

54. There are 15 Khalsa tanks, but except Uncha, which was constructed last Famine under the directions of Mr. Wakefield, all are small; and several of them, such as the tanks at Ander, Chikara, Pind, Soojakhera and Girdhana require repairs. The State Public Works Department should prepare estimates for them, and for repairing all the existing tanks where necessary, as soon as possible; and the work should be carried out without delay. Tanks.

55. Besides the Uncha tank, which was constructed during the Famine, Mr. Wakefield had surveys prepared for a very large project on the Kadmali River (see Project No. 1 Nimbahera Parganah, Appendix I). The site selected for the dam was near the village of Baroli, about 4 miles above the junction of the Kadmali with the Gameri, and 2½ miles north-east of Nimbahera town. (Site No. 1, Index Map). The dam line crosses the river where a natural bed of rock runs right across, where he suggests the weir should be placed.

New
Projects—
Kadmali
Project.

The catchment area is 149 square miles, and 20 per cent. of the average rainfall was allowed as available for storage, or 1,731 m.c.ft. Mr. Wakefield proposed to make his weir level 53 ft. above the river bed, giving a capacity of 1,461 m.c.ft., of which it was calculated that 1,444 m.c.ft. would be available for Irrigation, sufficient to command the 13,514 acres of land on the left bank within the Parganah, and up to the Mewar boundary.

The dam would have been 3 miles long and the weir 900 feet in length to discharge the maximum flood from the catchment area with a 5-feet head.

The basin is not a good one, as the river is in deep banks, and there is high land on either side, so that there would be little water-spread. No detailed Estimate was prepared, but the cost could not have been less than three lakhs.

The site was inspected by the Consulting Engineer in November 1903; but he "was not satisfied that the Project was a safe and sound one, and did not feel disposed to recommend it, at present at any rate." (See Appendix H.)

Instead, as the river continues running in ordinary years for some months after the rains, and the rock crossing formed an excellent site for constructing a weir, the Consulting Engineer considered that better use could be made of the water "by constructing a permanent weir in the bed of the river and by a small canal properly laid out leading the water at a uniform slope on to better land," where earthen banks would be made, forming shallow tanks, to store the water for Irrigation. Surveys for this revised project are therefore being made, and will be submitted in due course, and when carried out should form a very remunerative scheme, as the whole plain on the left bank, up to the Mewar border, is beautiful "mal" land.

Old Tank
at Bari.

56. As only the water flowing in the river after the rains will be used for the revised Kadmali project, we can now see what use can be made of the flood water during the rains on the catchment.

Just after the Kadmali passes the Tonk border, there was in old days a very large tank at Kishenpura (Site No. 2) near the village of Bari, formed by a dam closing the gap between the hills through which the river passed. The dam was built many years ago; the date is not known, nor when it breached; it is about 1,000 feet in length and built partly of earth, with a face-wall of large blocks of stone, and the remainder of earth alone. There is a weir 32 feet in length at the south end, and the breach occurs near the north end, and is about 200 feet in breadth.

Villages have sprung up in the bed, which is all excellent land and cultivated, and the boundary between Mewar and Tonk crosses the bed, so that if the breach was repaired Kishenpura village, belonging to Tonk, would be submerged, and perhaps Khara, which belongs to Mewar, and part also of the lands of Sajanpura (Mewar) and Makanpura (Tonk).

The catchment area is 23 square miles, and as it is all hilly 20 per cent. of the average rainfall of $21\frac{1}{2}$ inches would be available for storage, or 231 m.c.ft. of water, sufficient for 2,300 acres.

There would, no doubt, be great difficulty in making the necessary arrangements with Mewar to allow the dam to be repaired, but it would be worth while to have surveys made to see if Tonk has this amount of land commanded belonging to Bari and the villages north and south, which is at present unirrigated, and what land of Mewar would be submerged; and they could then decide whether it would be worth raising the question. The State Public Works Department could carry out this Survey without assistance.

Subauli
Project.

57. Failing this, five miles lower down the river there is a good site (Site No. 3) at Subauli, a village which is lying deserted since the Famine. The Dam would start from the high land on the left bank and cross the river to the hill on the right bank on which Subauli stands; then turning south-east it would cross the tributary nullah and end on the hill $\frac{1}{2}$ mile away.

The catchment area would be 37 square miles, and as a great portion of it is hilly 15 per cent. of the average rainfall should certainly be available for storage, or 281 m.c.ft., sufficient for 2,800 acres. Irrigation would be mostly on the left bank, and would extend along to the west of Dalan (deserted village) and Akia, where there is plenty of good land; and then north-east to Sagri and towards Nimbahera. There is a good basin, but some land of the Jagir village of Marjiwi would be submerged. The project would be an expensive one, as the hills are stoney and there is rock in the river bed, so a core-wall would be required for the whole length of the dam, which would be quite a mile in length. Provided there are sufficient cultivators to make full use of the water, it should certainly be carried out, and surveys will be prepared and submitted in due course, if the Durbar wish.



78197

58. Two miles to the east of Subauli, on the Daru, there is an excellent site for a large storage reservoir at Chota Kotri (Site No. 4), but the project could not be carried out unless Gwalior agreed, as the dam will pass into their territory.

Chota Kotri
Project.

Starting from the ridge on the left bank of the Daru, the dam would cross the river to the rocky hill on which Chota Kotri stands—the weir would be somewhere in this portion—then turning to the south-east along the ridge would cross the plain to the hill above Bari Baman village, which is in Gwalior territory.

A dam would probably be required across a gap in the hills on the left bank by Sarlahi village.

The catchment area is 42 square miles and nearly all hilly and rocky, so that 20 per cent. of the average rainfall may be allowed for storage, or 421 m.c.ft. of water, sufficient for 4,200 acres.

The Irrigation channel would be taken to the east of Kotri Bāra and Khera, across the railway on to the watershed between Piplian and Bangrera. Nothing can be done without Gwalior's assent, but the Tonk Durbar should apply for this, and if obtained, surveys can be made and Estimate and Plans prepared, and they would then know exactly the cost and value to the State if carried out.

59. On a tributary nullah there is a good site for a small tank at Kheri, 4 miles south-west of Nimbahera (Site No. 5).

Kheri Pro-
ject.

A small project was selected by Mr. Wakefield at Sewaria, half a mile above the site now proposed (see Project No. 2, Nimbahera Parganah, Appendix I), and the line for the dam has been daghbelled out and surveys made, but by constructing the dam at Kheri an extra 2 square miles of catchment would be secured, and this site itself is, it is thought, a better one.

Starting on the west (left bank) from the high ground by Saplia village the nullah would be crossed at Kheri, where there is a good rock crossing, and the dam would be continued on to the high ground on the east (right bank).

Sewaria, Saplia and Kheri are now all deserted, and though there is a good basin no wells or irrigated land would be submerged, and below there is good land commanded down to Ranikhhera on the left, and Manda on the right bank.

The catchment area is $5\frac{3}{4}$ square miles, and allowing 10 per cent. of the average rainfall of $21\frac{1}{2}$ inches as available for storage, the tank should be constructed with a capacity of 29 m.c.ft., sufficient to irrigate 290 acres.

60. Just above Bangrera, on the east border of the Parganah, and 5 miles east of Nimbahera, two nullahs join and the nullah thus formed flows in a north-west direction for 6 miles till it joins the Kadmalī River.

Bangrera
Project.

The land slopes gradually down to this nullah on either side, and is rich mal land, cultivated at present in the rains with jowar, and also producing wheat without irrigation. It is the finest stretch of land in the Parganah. By constructing a long earthen dam, just below the junction

of the nullahs and above Bangrera village (Site No. 6), a large tank could be formed close to the border, and the land below, for as much as there was water available, could be irrigated, and all the bed also as the water receded.

The catchment area is $15\frac{1}{2}$ square miles, and the tank should have a capacity of 118 m. c. ft. or 15 per cent. of the average rainfall on this area, rather more than the amount probably available in ordinary years, so as to store every drop.

Levels will show how long the dam will have to be made, but it will be entirely of earthwork, and should there be any excess water it might be allowed to spill over at either end.

To hold all this quantity the water will probably stretch back into Gwalior territory; and this State will certainly have to be entered to make the required surveys.

The sanction of the Gwalior Durbar should be obtained for this, and also if possible for the execution of the project as proposed, as all the land in the basin is at present "barani," and by the construction of the tank the portion in Gwalior territory which might be submerged would all be available for wheat cultivation as the water receded, and would be benefitted.

The project should, it is thought, bring in a handsome return on the capital expenditure. Being entirely of earth it would be comparatively cheap to construct, and the 1,150 acres of land below for which there would be water, if manured and irrigated, would produce 3 to 4 times the wheat crop now produced. If not carried out before this would form a splendid relief work.

Urgent
necessity
for Protec-
tive Irriga-
tion Works.

61. There are, no doubt, many other smaller projects on tributary nullahs in the Parganah, but if these two and the Subauli and Chota Kotri Projects are carried out, and the remainder of the water of the Kadmali utilized at the weir at Baroli (para. 55), a great attempt will have been made to make the fullest use—for the advantage and protection of the Parganah—of the water which at present runs to waste each year.

Considering the dreadful mortality that occurred in this Parganah last famine the urgency for protective measures is apparent.

It is sad to note the number of villages now empty and deserted; large areas of land are in consequence lying idle for want of cultivators, resulting in loss of revenue to the State.

Special inducements to attract new settlers are required, otherwise there seems little chance of improvement. Given a good administration, water available for irrigation should prove one of the chief inducements.

For every reason therefore it is trusted that the Tonk Durbar will be able to make the necessary arrangements, both political and financial, for the construction of the works recommended in this Report.

F. ST.-G. MANNERS SMITH,
SUPERINTENDING ENGINEER,
Protective Irrigation Works, Rajputana.

7th February 1905.

Note by Consulting Engineer on Irrigation in the Tonk State.

At the request of the Superintending Engineer (Mr. Manners Smith), I visited the Tonk State with him from 12th to 18th January 1905, and rode with him about 145 miles through the northern portion of the Tonk State.

2. The object was to see some of the Projects proposed by Mr. Wakefield, when he was connected with the Tonk State, alluded to in the printed Note by him on "Irrigation in the Tonk State"; and to see if any other good Irrigation Projects could be suggested.

3. The following places were visited—Bugri, Jawali, Sandero, Chandlai and Dakia.

Inspection Notes on each of the works proposed at these places are attached. These places are all near Tonk, or in the northern portion of the State. As there appeared to be no necessity for the Consulting Engineer to remain longer at present here, on the 18th January he returned to Jaipur, preparatory to visiting the Bikaner State, and the Superintending Engineer continued his tour through the remaining portion of the Tonk State.

4. The Report which is submitted by the Superintending Engineer, after he had completed his investigations, deals with the whole subject, and is as clear and comprehensive as all his Reports are, and it will be unnecessary for me to say more here, in addition to the notes attached on the places visited, than to emphasize one or two points connected with Irrigation, which I think deserve attention.

5. The Tonk State, apparently, has many places for storing water; the soil is generally first class, and small tanks are met with at almost every village. Many of these are not kept up in a proper state of repair. In some cases the supply is not sufficient, surface or nullah drainage is not taken full advantage of, the earthwork is not level, and the escape is sometimes not kept up to the proper mark; many tanks belong to Jagirdars, who, perhaps, have not the means to keep them in proper condition, if they have the desire even to do so. The resources of the State are limited, the State at present is in debt, so that it is impossible or inadvisable to suggest large Projects which would take some years perhaps to develop, and in the meantime, if constructed with borrowed money, would entail a burden on the State to repay the interest on the outlay. These are conditions which have to be taken into consideration.

6. But existing tanks should certainly be all put into a proper state of repair, and steps might be taken, which would cost little, as a preliminary measure, *viz.* :—

(a) A statement might be prepared showing all existing tanks in the State with a serial number to each, with note,

whether K. (khalsa) or J. (Jagir); with columns to give the length and nature of bund; whether in proper state of repair or not; what work, if any, was necessary to make the tank efficient; what area, if any, is now irrigated from it; the average depth of water in the wells adjacent; and a column for any suggestions. If a blank statement with these headings is circulated to every official in the district, to be filled in and returned, the Durbar would be in possession of much information which at present is wanting.

7. The next step would be to get one or two good Overseers to go round the district, and prepare Estimates for every tank that required repairs, so that the Durbar would know where to sanction work and the amount it would cost, and as funds are available each work might be taken up in the order of its importance. If every village tank is in good condition it would give the people greater powers of resisting scarcity, and there are many advantages which cannot be estimated in rupees. It would be well, too, to take the opinions of the Revenue Officials before carrying out any Project.

8. In my opinion, while it is advisable to have two or three good new projects, which the Superintending Engineer, Mr. Manners Smith, is arranging for, properly surveyed and estimated, ready to carry out at any time, it is of the first importance to have all existing works put into a proper condition. No money can be spent in a better way. But Irrigation like anything else to ensure success needs to be carried out systematically with energy and perseverance.

When funds are not available it is impossible to expect any real progress, and it seems hopeless to make suggestions; at the same time when a real interest is shown in the subject by the officials connected with the administration, there is hope that something will be done, and if properly done, the benefit to the State and people is certain to follow.

9. Before closing these remarks I wish to acknowledge the help we have received from the officials connected with the State, especially from Mr. Damodar Rao, the member in charge of this branch, who accompanied us to the places noted, and gave us all the information and help he could.

S. S. JACOB, COLONEL,
Consulting Engineer for Irrigation.

February 1905.

APPENDIX A.

Note on the Bagri Project, Tonk State.

13th January 1904.

Mr. Wakefield, in his Report, describes this work thus:—"The proposed bund will contain $50\frac{1}{2}$ lacs c. ft. earthwork. Of this quantity $5\frac{1}{2}$ lacs c. ft. were done as a Famine Relief work on both flanks of the nullah, which remains to be dammed." He adds, "In my opinion a core-wall of rammed kankar for the nullah crossing will suffice. The overflow channel should be situated on the right bank of the nullah as shown. The design for the head of the distributary and the Estimate of cost remain to be done, and can be completed when there is a likelihood of the work being put in hand."

2. Mr. Manners Smith and I carefully inspected the work and the site. Babu Damodar Rao, the Finance Minister of Tonk; the Nazim; and the Overseer Abdul Latif, who prepared the Plans, were with us.

3. The Project requires to be properly completed:—

- (a) 20 per cent. of the average rainfall of 25 inches, taken in the original Project (considering the sandy nature of the catchment), appears to me to be too much; 10th is probably as much as will be received in ordinary years.
- (b) The catchment area does not appear to be so large as supposed.
- (c) This will reduce the quantity of water available for storage, and make a considerable difference in the figures.
- (d) The line proposed for the bund across the nullah appears not to be the best.
- (e) A pucca well, known as "Marwa" or Patels' well, has been taken just inside the bund line, and might be easily saved.
- (f) Neither this well nor a pucca chabutra have been shown on the plan.
- (g) It is not known what land can be irrigated.
- (h) The capacity of the tank at different contours is not known.
- (i) The Estimate has not been prepared, so the total cost of the work is not known.

4. I would make the following suggestions:—

- (1) The Project to be prepared *de novo*.
- (2) The escape may be left as proposed by Mr. Wakefield; the overflow to pass off on the natural surface at the north end of the bund, not "the right bank of the nullah," as stated.

- (3) The quantity of water available to be taken as $\frac{1}{10}$ th of the average rainfall ; and the catchment area to be re-checked.
- (4) The bund line to be slightly altered so as to cross the nullah as decided to-day at the site, and to pass inside the "Marwa " or Patels' well.
- (5) There is no necessity for a core-wall, I think, if good sand is used and the bund is made not less than 15 ft. thick at the top, and with inner slope of 4 to 1, and outer slope of 2 to 1 ; all jungle scrub being removed, and the new work well trenched into the original ground, and into the banks on each side. Leakage, no doubt, will occur, but if it occurs to any extent the toe of the outer slope can be made with bagri and broken stone to prevent the leakage from doing any harm.
- (6) The land to be irrigated to be shown on the Plan and the line of canal to be surveyed, and taken if possible *above* the Bagri village tanks, so that they may be replenished by it.
- (7) Where the canal will cross a nullah and broken ground, at about 1,500 feet distant from the bund, proper arrangements to be made for crossing this by syphon or level crossing, as may be found to be most convenient.
- (8) A proper Estimate to be prepared for completing the work, from which it will be possible to state the probable cost and probable returns.

5. To what extent the work will be remunerative it is difficult to say until proper Plans and Estimate have been framed ; but as the work has been already partly done, it ought, I think, to be completed. It is a good Famine Relief work, even if not remunerative, and to leave it as it is would be waste of money.

6. The advantage which may be expected from the silting up of the broken ground inside and the increased cultivation of the bed, which no doubt will follow, and the benefit that will probably be derived from percolation of the water stored here, and so benefit wells below, all these are considerations which encourage one to finish the work now that it has begun.

APPENDIX B.

Note on the Sohodra Project.

14th January 1905.

Rode from Bagri to Jawali, and inspected site of proposed bund here, across the Sohodra River, distance 15 miles.

Mr. Wakefield states:—"The proposed site for the bund lies near the village of Jawali, 9 miles west of the City of Tonk. This nullah has already been dammed by the Jaipur State at Tori, and a tributary of it at Chandsen. But below both the above places and up to the village of Jawali, where a suitable bund site exists, the catchment area is considerable, viz., 139½ square miles. Good irrigable lands lie below, and the project is well worth completing."

"A certain amount of field work has already been done, but requires completion."

2. From an inspection of the site I do not think it a good project; there is no clearly defined basin before any water is stored, it would have to rise above the banks of the nullah, which are here about 20 ft. deep, and as the country is open it will require a long bund to effect any storage. The soil on the north or left bank is good for a bund, but there is no rock visible in the river, which is about 400 ft. broad. There are traces of rock on the south or right bank only, and what is visible near the edge is of inferior quality. The soil on the south bank, where the line of the bund is taken, is hard soil mixed with kunkar; rock may exist below, but there is no good soil near to make an earthen bund.

The portion in the river bed would require a masonry core-wall, taken down 10 to 15 ft. deep; and all on the south side of the nullah, about 2,000 ft. long, would require a masonry face-wall.

The only place for an escape appears to be the natural surface of the ground at the south end of the proposed bund.

The ground below for 2 or 3 miles is not, I consider, favourable for irrigation, and is greatly cut up by the nullah itself and subsidiary nullahs, which intersect the ground, and would have to be crossed by any canal. Villages beyond this distance might be irrigated, but the cost of the project would be considerable, and I do not think, considering the financial condition of the Tonk State, and the drawbacks noted, it would be advisable to spend money in preparing a project here. Any funds available for irrigation would, I think, be better spent in smaller Projects. Moreover, much of the drainage calculated on, unknown apparently to Mr. Wakefield, has been already cut off by works in the Jaipur State, notably at Kharamda, Phundarai and Thalandu; while other Projects are in contemplation at Hamirpur, Bhawalpur, and below Karela at Nagpani.

APPENDIX C.

Note on the Proposed Storage Tank at Miarampura.

15th January 1905.

Rode from Jawali, *via* Miarampura, to Hirapura and back to Sandaro, 16 miles.

Near Miarampura inspected the site for a storage tank, about $\frac{3}{4}$ -mile east of the village of Dodario, and $\frac{1}{4}$ -mile east of Miarampura. The village is in Jagir of Mohammed Zahur-ul-Islam, a courteous native official of Tonk; when asked if he had any objections to a tank being made here he expressed satisfaction. The village is said now to contain only two families. The site appears to be a good one. The drainage area of about 9 square miles passes here. There is an old talao on the right bank, about $\frac{1}{2}$ -mile east of Miarampura, which at present is useless; a great portion of this bund can be used in the proposed bund, which would join on to it and then stretch northward across the nullah, which is well defined, about 25 ft. wide and 10 ft. deep, on to high ground in a north-west direction.

The soil is good, excepting at the north side of the nullah, where a trench should be dug 3 ft. deep and filled in with earth of a better description, of which also the bund should be made.

The nullah does not pass through the lowest ground which is nearest the old talao. It would be a safe precaution to make a masonry core-wall in the nullah portion of the dam; though if good earth is used, and is well bonded into the banks on both sides, I do not think a masonry core-wall is absolutely necessary.

The only place for the escape appears to be the level ground at the south end of the old talao. If the overflow is allowed to pass over a long level portion of the natural ground it may pass away quietly, but if it is found to cut back, or do any harm, then it will be advisable to form a masonry escape in the bund at the nearest point of the bund to the bend of the nullah, and to let the overflow pass off here; but this may not be necessary. There appears to be good land, though somewhat limited, at some little distance below the bund, which could be irrigated. The project seems quite a promising one, and I would suggest Plans and Estimate being prepared.

APPENDIX D.

Note on the Hirapura Project.

15th January 1905.

On reaching Hirapura we were shown a site where it had been suggested an earthen bund might be formed on the nullah, which rises in the Lawa State and flows on the west side of this village.

2. The soil is all sandy, the land below is much cut up with ravines and broken ground, and although it is not likely that water if stored here could be made use of, still it would be quite possible to make an earthen bund across the gap shown us, which is about 700 ft. across, and by making it high to impound all, or nearly all, the water which can be expected. As this nullah has been impounded already in the Lawa State, only the rainfall south of the Lawa State can be depended upon. The project will not, I think, be financially remunerative.

APPENDIX E.

Note on the Sandaro Project.

15th January 1905.

We then rode to Sandaro village. There are grand ledges of rock across the nullah here, close to the village, extending up stream for about 500 yards, where apparently a good masonry dam or weir might be made at small expense. The best site appears to be where the rock begins. A curved weir might be very easily made here, in plan part of an arch, with the convex side facing up stream, following the natural line of the rock. If levels are taken from here it will be seen if it is possible to take a supply cut from this weir on both banks—on the left in a south-easterly, and on the right in a south-westerly direction. If one, or both, is possible it will enable the flood waters to be diverted to lower ground (as the country slopes to the south) and perhaps to be stored where it may be able to benefit the country, instead of going to waste as it now does.

The village of Sandaro is said to be at times in great want of water; so any weir built across the nullah here would benefit the village also.

The drainage area at this point is about 20 square miles. Allowing 10 per cent. of a rainfall of 25 inches there ought to be about 116 m.c.ft. available for storage.

The depth of excavation for the canals will depend upon the height of the weir; and after levels have been taken it will be possible to fix the best height, probably 10 or 15 ft.

There is any amount of good land commanded in the direction of Piplo, and some small village tanks also, which might be benefitted by such a supply cut.

The canal on the right bank does not look so hopeful, but until levels have been taken it is not possible to say much.

APPENDIX F.

Note on the Chandlai Tank.

16th February 1905.

At 3 p.m. drove out to Chandlai, where we were met by Babu Damodar Rao, and other officials, to inspect and advise them regarding an earthen bund lately made here.

2. The soil is very poor, rat holes are abundant, the inner slope originally 3 to 1 has been much cut up by the wash of the water; at the top it is vertical in many places, and below this the inner slope has been washed down to 6 to 1 or more. The top of the bund is said to be fixed at R. L. 105; the escape, which ought to be 5 ft. lower (R. L. 100), at present is found to be R. L. 103.

3. The tank breached near the south end last rains, and was also cut open near this place to relieve the pressure; and it was stated that it was the intention to raise the bund 2 ft. or so to enable the water to pass off at the place originally proposed for the escape.

4. Considering the nature of the soil and the fact that the bund has already breached with the present head of water, and is exposed to the full force of the south-west wind and the waves caused by it, I do not think the earthwork will safely stand water at a higher level than R. L. 100.

I would suggest that the bund be not raised higher than it is at present.

- (a) The high water level be fixed at R. L. 100.
- (b) That a new escape be made at the south end where the natural surface of the ground is at the reduced level 100.
- (c) That the portion where the water previously escaped be allowed to remain open, and a new portion of bund be made to connect the present work, where it is unbreached, up to the higher ground at R. L. 100, the end to be protected with dry rubble pitching, so that the surplus water (above H. W. L., *i.e.*, R. L. 100) may pass round this end and flow safely away over the natural ground.
- (d) That the small talao at the east end which was connected with the bund, and is now separated from it by the breaches in the bund, be allowed to remain separate.
- (e) That the inner slope be everywhere made up to proper section, *i.e.*, 4 to 1, or, as it now is, up to H. W. L. and above H. W. L. 1 to 1; the foot of the upper slope to be protected either by rubble stone, or ballast, or kunkar, or sods of turf, or fascines made of cotton stalks, or coarse grass, so that the front slope above H. W. L. shall be

made 2 to 1, that is, the triangular space between 1 to 1 and 2 to 1 be made up with something to protect the part above H. W. L. so that the action of the waves at H. W. L. shall not be able to undermine it. The fascines to be about 9 inches in diameter, and in lengths of 8 or 10 ft. firmly tied round with rope of some kind at every 3 ft. and securely fixed into the bank by long wooden pegs, or fascines buried in the earth as headers.

The cutting away will begin at this point, and means must be taken to protect this permanently as suggested with stone or kunkar ; or temporarily with brushwood or fascines of cotton stalks or grass, if nothing better is obtainable ; the latter will, however, require renewal occasionally.

In any case the bund, I fear, is not to be trusted, and will require constant and careful watching during the rains.

APPENDIX G.

Note by Consulting Engineer on the Dakia Project.

17th January 1905.

Started 8 A.M., drove to Dakia and back, and inspected site of a proposed Storage Reservoir about 1 mile east of Dakia ; returned 12 mid-day, total distance 26 miles. Mr. Damodar Rao and the Nazim met us at the site. This is one of the projects mentioned by Mr. Wakefield in his Note on the Investigation of Famine Protective Works in the Tonk State, as follows:—

“Situation 11 miles south and south-west of the City of Tonk. A site plan is attached. The field work is nearly finished, and the Plans will be submitted shortly. This work was lately undertaken to keep the Surveyors employed, pending definite orders on the subject of their retention or otherwise.”

The site is between Dakia and Sandela. The storage basin is a fine one, the nullah is well defined, the soil a rich loam, mixed with small kunkar in places, but still suitable, I think, for an earthen bund if properly joined with the original ground surface, and well trenched in the bed and sides of the nullah.

The catchment is stated to be 37 square miles ; it is doubtful if the areas intercepted by other tanks above have been deducted or whether the cultivated area and value which apparently will be submerged near Sandela has been considered. No Estimate has been prepared yet. There appears to be no good site for an escape. Taking the bed of the nullah as R. L. 60, it is proposed to impound water to R. L. 94. The crest of the Dam to be 99. The bed of the Canal to be R. L. 85. This means that 25 feet of water will be left unused, and only the upper 9 feet would be available for Irrigation. If the sluice to supply the canal can be put lower, it will be an advantage. The proposed line for the canal is shown on the Plan, but has not been checked on the ground, and from the appearance of the ground it seems advisable to have this checked.

The ground below, between it and Dakia, is much cut up with ravines ; the only hope of any irrigation is in the direction of Arnia, and then onwards towards Tonk, according as the levels admit. There is any amount of first-class level land in this direction, and if the water can be made to reach this area at a reasonable cost it ought to pay well.

As a Famine Relief Work it appears nothing could be better, as nearly all the work will be earthwork. Until further data is obtained, and an Estimate has been prepared, it is impossible to say more. The Superintending Engineer has arranged to have proper Plans and Estimates prepared.

APPENDIX H.

Inspection Note by the Consulting Engineer on the Kadmali Project. Nimbahera Parganah.

On the 18th November 1903 inspected the site of the proposed Storage Reservoir on the Kadmali River, about 2 miles north-east of Nimbahera.

This is one of the projects proposed by Mr. Wakefield when he was connected with the Tonk State. He and Mr. Manners Smith, the Superintending Engineer, accompanied me.

There is good rock for some 800 feet or so on the left bank, which would supply material for masonry if it was required, and forms a good place for an escape, but it is some 30 to 40 feet below the H. W. L. of the proposed reservoir.

The right bank of the river is of good hard moorum about 25 feet high, and almost vertical; the remaining portion of the proposed bund, about $1\frac{1}{2}$ miles long on each side of the nullah, is good black soil, but the surface of the ground is a good deal cracked.

There is a stream of about 150 *laos* now (18th November) flowing in the nullah, but it is said cannot always be depended on.

The basin is not a very good one for storage, owing to the extent of high ground within it; and the banks of the river being about 25 feet deep, there is no spread of water, except at a high level, or above 25 feet.

The ground below slopes generally towards the river, but there is a large area which could be irrigated if water could be supplied, and there are cultivators to take advantage of it.

The detailed information regarding the Project is all noted, as far as it has been prepared, in the papers attached; it seems unnecessary therefore to repeat them here.

The Estimate has not been fully prepared yet, but the cost will probably be 3 or 4 lakhs of rupees.

Taking all the circumstances into consideration, the project as proposed seems to me to be too large and too expensive. It is true the detailed Estimate has not been worked out, but as far as I can judge I am not satisfied that it is a safe and sound one, and do not feel disposed to recommend it, at present at all events. The time may come when the value of water may be fully appreciated, or funds may be available for such a large work; it will be well therefore to place all the papers connected with the project on record.

In the meantime, when we are told that owing to the recent Famine the population of this Parganah has decreased 39 per cent., that 75 per cent.

of the cattle have perished, and that 36,000 bighas of good land were lying fallow, it shows the need of doing anything that is possible here to benefit the country and the people.

It has been observed that there is water now flowing in the river ; some of this no doubt will be used for cultivation in the river bed later on, but it seems better use can be made of it by constructing a permanent weir in the bed of the river, and by a small canal properly laid out, leading the water at a uniform slope on to better land.

Another point deserving of consideration is, that instead of allowing all the water during the rains, or for sometime afterwards, to run to waste as it now does, it may be possible by the permanent weir and canal to divert a portion to land a few miles lower down, and store it in shallow tanks made on the natural surface.

These would be merely earthen banks made to hold up 5 feet or more of water, which could be let out when required to the fields below, and the bed inside be cultivated. These tanks might be made of any size, and would only be limited by the possibility of getting suitable and level ground.

I would suggest investigations being made, and if it seems to be possible, that Plans and Estimates be prepared as soon as possible. A work of this sort seems to me to be better adapted to the circumstances at present ; the cost will be small, it is more easily and quickly completed, and more likely to bring in a good return, it does not interfere with the large storage project, but is only the first step, as it were, towards it. And when the Durbar are satisfied that the water can be profitably used, there will be more hope of the larger project being considered.

APPENDIX. I.

NOTE

ON THE

INVESTIGATION OF FAMINE PROTECTIVE WORKS

IN THE

TONK STATE.

BY

G. E. C. WAKEFIELD,
Superintendent Revenue Administration,
TONK.

INDEX.

| PARA. | | PAGE. |
|-------|--|-------|
| 1 | Area and Constitution of the State | 5 |
| 2 | Guiding Principles on which Report is framed ... | 5 |
| 3 | Past history and future importance of Irrigation ... | 5 |
| 4 | Details of the Investigation | 5 |

Projects in Rajputana.

TONK PROVINCE :—

| | | | |
|---|------------------------------|--------|----|
| 5 | (a) Chandlai Project | | 7 |
| 5 | (b) Bagri Project | | 9 |
| 5 | (c) Dakia Project | | 11 |
| 5 | (d) Shodra Naddi Project | | 13 |
| 5 | (e) Other Projects suggested | | 13 |
| 6 | ALIGARH PROVINCE | | 15 |

NIMBAHERA PROVINCE :—

| | | | |
|---|---------------------------|--------|----|
| 7 | (a) Kadnali River Project | | 17 |
| 7 | (b) Sagwaria Project | | 17 |

Projects in Central India.

CHABRA PROVINCE :—

| | | | |
|----|---|--------|----|
| 8 | (a) Retli River Project | | 19 |
| 8 | (b) Inundation Canals | | 19 |
| 9 | SIRONJ PROVINCE | | 21 |
| 10 | PIRAWA PROVINCE | | 21 |
| 11 | General Remarks | | 23 |
| 12 | Proposals for the continuance of the work | | 23 |
| 13 | The Vital Importance of Irrigation | | 23 |